U.S. DEPARTMENT OF COMMERCE
National Technical Information Service

PB-269 042

Perry Reservoir
Jefferson County, Kansas

National Eutrophication Survey, Corvallis, Oreg

Prepared for

Corvallis Environmental Research Lab, Oreg

May 77

PB 269 842

U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EUTROPHICATION SURVEY
WORKING PAPER SERIES

CORVALLIS ENVIRONMENTAL RESEARCH LABORATORY - CORVALLIS, OREGON
and
ENVIRONMENTAL MONITORING & SUPPORT LABORATORY - LAS VEGAS, NEVADA

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U.S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

PB 269 842

REPORT

ON

PERRY RESERVOIR

JEFFERSON COUNTY

KANSAS

EPA REGION VII

WORKING PAPER No. 521

WITH THE COOPERATION OF THE

KANSAS DEPARTMENT OF HEALTH AND ENVIRONMENT

AND THE

KANSAS NATIONAL GUARD

MAY, 1977

TECHNICAL REPORT DATA

(Please read Instructions on the reverse before completing)

1 REPORT NO.	2 RECIPIENT'S ACCESSION NO.
4 TITLE AND SUBTITLE: Report on Perry Reservoir, Jefferson County, Kansas	5 REPORT DATE: Prepared May 1977
	6 PERFORMING ORGANIZATION CODE
7 AUTHOR(S): Anonymous (National Eutrophication Survey Staff)	8 PERFORMING ORGANIZATION REPORT NO: Working Paper # 521
9 PERFORMING ORGANIZATION NAME AND ADDRESS: National Eutrophication Survey U.S. Environmental Protection Agency 200 S. W. 35th St. Corvallis, Oregon 97330	10 PROGRAM ELEMENT NO.
	11 CONTRACT/GRANT NO.
12 SPONSORING AGENCY NAME AND ADDRESS: Office of Research and Development U.S. Environmental Protection Agency 401 M Street, S. W. Washington, DC 20460	13 TYPE OF REPORT AND PERIOD COVERED: Final - 1974 14 SPONSORING AGENCY CODE

15 SUPPLEMENTARY NOTES

Prepared in cooperation with the U.S. Environmental Protection Agency, National Environmental Research Center, Las Vegas, Nevada 89114

16 ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

17 KEY WORDS AND DOCUMENT ANALYSIS

a DESCRIPTORS	b IDENTIFIERS/OPEN ENDED TERMS	c COSATI Field/Group
eutrophication lakes nutrients phosphorus nitrogen loading		08H 08C

18 DISTRIBUTION STATEMENT	19 SECURITY CLASS (This Report)	21 NO. OF PAGES
Release unlimited	20 SECURITY CLASS (This page)	22 PRICE PCAC7 / MF

EPA Form 2220-1 (9-73)

CONTENTS

	Page
Foreword	ii
List of Kansas Study Reservoirs	iv
Lake and Drainage Area Map	v
Sections	
I. Conclusions	1
II. Lake and Drainage Basin Characteristics	4
III. Lake Water Quality Summary	6
IV. Nutrient Loadings	10
V. Literature Reviewed	16
VI. Appendices	17

FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's freshwater lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Kansas State Department of Health and Environment for professional involvement, to the Kansas National Guard for conducting the tributary sampling phase of the Survey, and to those Kansas wastewater treatment plant operators who voluntarily provided effluent samples and flow data.

The staff of the Kansas Division of Environmental Health provided invaluable lake documentation and counsel during the Survey, reviewed the preliminary reports, and provided critiques most useful in the preparation of this Working Paper series.

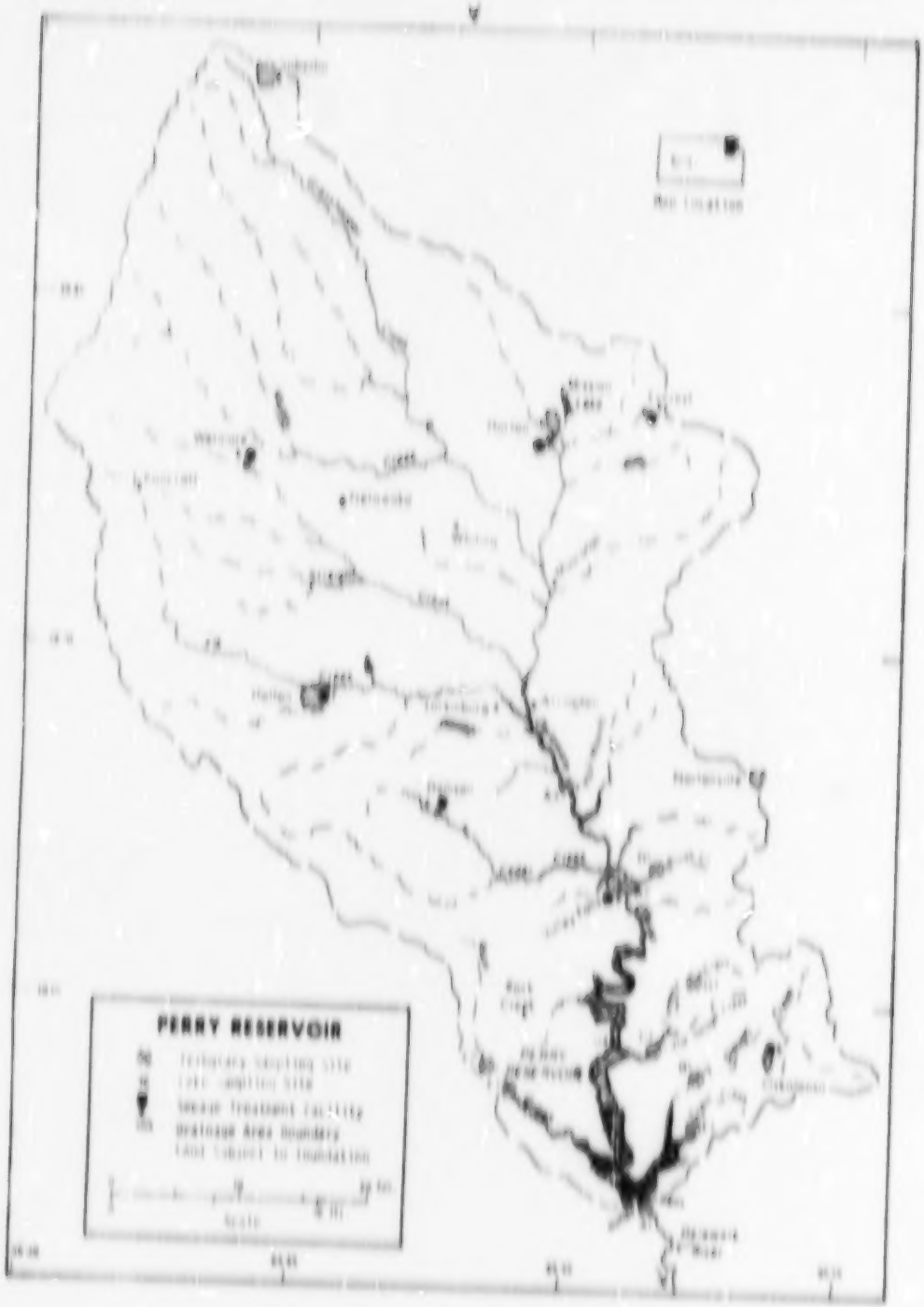
Major General Edward R. Fry, the Adjutant General of Kansas, and Project Officer Colonel Albin L. Lundquist, who directed the volunteer efforts of the Kansas National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY RESERVOIRS

STATE OF KANSAS

NAME	COUNTY
Cedar Bluff	Trego
Council Grove	Morris
Elk City	Montgomery
Fall River	Greenwood
John Redmond	Coffey, Lyon
Kanopolis	Ellsworth
Marion	Marion
Melvern	Osage
Milford	Clay, Geary
Norton	Norton
Perry	Jefferson
Pomona	Osage
Toronto	Greenwood, Woodson
Tuttle Creek	Marshall, Pottawatomie, Riley
Wilson	Russell


PERRY RESERVOIR

PERRY RESERVOIR

STORET NO. 2011

I. CONCLUSIONS

A. Trophic Condition:

Survey data indicate that Perry Reservoir is potentially eutrophic. However, the reservoir becomes quite turbid during periods of runoff, and primary productivity is intermittently light-limited (Kring, 1977).

This water body ranked ninth in overall trophic quality when the 15 Kansas reservoirs sampled in 1974 were compared using a combination of six water quality parameters*. Seven of the reservoirs had less median total phosphorus, eight had less median dissolved orthophosphorus, 11 had less and one had the same median inorganic nitrogen, two had less mean chlorophyll a, and six had greater mean Secchi disc transparency. Depression of dissolved oxygen with depth occurred at all sampling stations in June.

Survey limnologists did not observe any nuisance conditions during their sampling but did note that the reservoir was quite turbid at times.

B. Rate-Limiting Nutrient:

The algal assay results indicate that Perry Reservoir was phosphorus limited at the time the sample was collected (02/12/74).

* See Appendix A.

The reservoir data indicate phosphorus limitation at all sampling stations and times. However, because of turbidity, primary productivity in the reservoir is intermittently light-limited rather than nutrient-limited.

C. Nutrient Controllability:

1. Point sources--During the sampling year, the listed point sources accounted for 18.0% of the total phosphorus load to Perry Reservoir. The wastewater treatment plant at Morton contributed 7.4%, the facility at Melton contributed 7.2%, the plant at Wetmore contributed 0.4%, and the remaining four plants were estimated to have collectively contributed 3.0%.

The present phosphorus loading of 2.07 g/m^2/year is 4.7 times that proposed by Vollenweider (Vollenweider and Dillon, 1974) as a eutrophic loading (see page 15). Even though nutrient-wise the reservoir is phosphorus-limited, reduction of the point-source phosphorus loads may not result in a significant improvement of the trophic condition because of light-limitation. In a previous report it is noted that while nutrient levels in Perry Reservoir are high, aquatic growths are not excessive due to high turbidity resulting from soil erosion in the drainage of the reservoir (Anonymous, 1975). However, if soil conservation projects are initiated to reduce erosion and the resulting turbidity in the reservoir, the present phosphorus loading is likely to result in the development of nuisance aquatic vegetation.

2. Non-point sources--Non-point sources contributed 82.0% of the total phosphorus load during the sampling year. The Delaware River contributed 71.0%, Slough Creek contributed 1.3%, Little Slough Creek contributed 0.4%, and Rock Creek contributed 0.8%. Ungaged minor tributaries and immediate drainage contributed an estimated 7.6%.

II. RESERVOIR AND DRAINAGE BASIN CHARACTERISTICS†

A. Morphometry††:

1. Surface area: 49.37 kilometers².
2. Mean depth: 3.7 meters.
3. Maximum depth: 11.9 meters.
4. Volume: 182.669 x 10^6 m^3.
5. Five-year median hydraulic retention time: 281 days.

B. Tributary and Outlet:
(See Appendix C for Flow data)

1. Tributaries -

Name	Drainage area (km^2)*	Mean flow (m^3/sec)*
Delaware River (at A-3)	1,942.5	9.110
Slough Creek	109.8	0.650
Little Slough Creek	47.1	0.088
Rock Creek (at E-2)	35.5	0.200
Minor tributaries & immediate drainage -	708.7	3.472
Totals	2,843.6	13.520**

2. Outlet -

Delaware River	2,893.0***	12.710

C. Precipitation****:

1. Year of sampling: 75.3 centimeters.
2. Mean annual: 92.4 centimeters.

† Table of metric conversions--Appendix B.
†† Kring, 1977.
* For limits of accuracy, see Working Paper No. 175, "...Survey Methods, 1973-1976".
** Total inflow adjusted to equal outflow plus evaporation loss.
*** Includes area of reservoir.
**** See Working Paper No. 175.

III. WATER QUALITY SUMMARY

Perry Reservoir was sampled three times during the open-water season of 1974 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from a number of depths at four stations in April and five stations in June and October (see map, page v). During each visit, a single depth-integrated (near bottom to surface) sample was composited from the stations for phytoplankton identification and enumeration; and during the first visit, a single 18.9-liter depth-integrated sample was composited for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll a analysis. The maximum depths sampled were 15.2 meters at station 1, 9.1 meters at station 2, 13.7 meters at station 3, 9.1 meters at station 4, and 8.2 meters at station 5.

The sampling results are presented in full in Appendix D and are summarized in the following table.

4. Biological Characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal Units per ml
04/12/74	1. Stephanodiscus sp.	891
	2. Chroomonas sp.	806
	3. Melosira sp.	806
	4. Cryptomonas sp.	127
	5. Chlorococcal cells	127
	Other genera	338
	Total	3,095
06/25/74	1. Cryptomonas sp.	368
	2. Flagellates	221
	3. Trachelomonas sp.	184
	4. Chroomonas sp.	147
	5. Coelastrum sp.	37
	Other genera	146
	Total	1,103
10/02/74	1. Chroomonas sp.	741
	2. Melosira sp.	456
	3. Nitzschia sp.	456
	4. Cryptomonas sp.	285
	5. Skeletonema sp.	114
	Other genera	141
	Total	2,193

Sampling Date	Dominant Genera	Chlorophyll a (ug/l)
04/12/74	1	5.1
	2	13.2
	3	9.6
	4	7.1
	6	-
06/25/74	1	4.3
	2	4.9
	3	1.5
	4	0.9
	6	2.9
10/02/74	1	3.0
	2	5.2
	3	6.2
	4	12.6
	6	1.9

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.010	0.791	7.4
0.250 P	0.060	0.791	25.0
0.050 P + 1.0 N	0.060	1.791	34.9
1.0 N	0.010	1.791	6.5

2. Discussion -

The control yield of the assay alga, Selenastrum capricornutum, indicates that the potential primary productivity of Perry Reservoir was high at the time the sample was collected (04/12/74). Also, the increase in yield with the

addition of phosphorus alone indicates that the reservoir was phosphorus limited at that time. Note that the addition of nitrogen alone resulted in a yield no greater than that of the control.

The reservoir data also indicate phosphorus limitation. The mean inorganic nitrogen/orthophosphorus ratios were 36/1 or greater at all sampling stations and times, and phosphorus limitation would be expected. However, primary productivity in the reservoir is intermittently light-limited rather than nutrient-limited (Kring, 1977).

IV. NUTRIENT LOADINGS
(See Appendix F for data)

For the determination of nutrient loadings, the Kansas National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v), except for the months of May, June, and July when two samples were collected at most of the sites. Sampling was begun in October, 1974, and was completed in September, 1975.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Kansas District Office of the U.S. Geological Survey for the tributary sites nearest the reservoir.

In this report, nutrient loads for sampled tributaries were calculated using mean annual concentrations and mean annual flows. Nutrient loads shown are those measured minus point-source loads, if any.

Nutrient loads for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated using the mean concentrations in Brush Creek at station D-1 and the mean annual ZZ flow.

The operators of the Everest, Holton, Horton, and Wetmore wastewater treatment plants provided monthly effluent samples and corresponding flow data. The operators of the wastewater treatment plants of Denison, Oskaloosa, and Valley Falls did not participate; nutrient loads from these sources were estimated at 1,134 kg P and 3,401 kg

N/capita/year, and flows were estimated at 0.3785 m³/capita/day.

A. Waste Sources:

1. Known municipal* -

Name	Pop. Served	Treatment	Mean Flow (m^3/d)	Receiving Water
Denison	278	stab. pond	105.2	North Cedar Creek
Everest	359	stab. pond	113.1	Grasshopper Creek
Hatton	3,369	tr. filter	1,617.2	Elks Creek
Horton	8,385	tr. filter	2,206.9	Delaware River
Ostelousa	1,005	stab. pond	380.4	Big Slough Creek
Valley Falls	1,291	stab. pond	466.6	Delaware River
Wetmore	415	tr. filter	98.3	Spring Creek

2. Known industrial -

Name	Treatment	Mean Flow (m^3/d)	Receiving Water
Meat Packing Plant, Hatton**	anaerobic - aerobic ponds	?	Elks Creek

* Treatment plant questionnaires.
** Not in operation during the sampling year.

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/ yr	% of total
a. Tributaries (non-point load) -		
Delaware River (A-3)	72,665	71.0
Slough Creek	1,360	1.3
Little Slough Creek	455	0.4
Rock Creek (E-2)	775	0.8
b. Minor tributaries & immediate drainage (non-point load) -	7,775	7.6
c. Known municipal STP's -		
Denison	315	0.3
Everest	165	0.2
Holton	7,385	7.2
Horton	7,615	7.4
Oskaloosa	1,140	1.1
Valley Falls	1,465	1.4
Wetmore	370	0.4
d. Septic tanks - Unknown	?	-
e. Known industrial - None	-	-
f. Direct precipitation* -	865	0.9
Total	102,350	100.0

2. Outputs -

Reservoir outlet - Delaware River 24,850

3. Net annual P accumulation - 77,500 kg.

* See Working Paper No. 175.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/ yr	% of total
a. Tributaries (non-point load) -		
Delaware River (A-3)	473,270	60.9
Slough Creek	24,520	3.2
Little Slough Creek	5,325	0.7
Rock Creek (E-2)	10,695	1.4
b. Minor tributaries & immediate drainage (non-point load) -	172,670	22.2
c. Known municipal STP's -		
Denison	945	0.1
Everest	360	<0.1
Holton	11,395	1.5
Horton	16,110	2.1
Oskaloosa	3,420	0.4
Valley Falls	4,390	0.6
Wetmore	480	<0.1
d. Septic tanks - Unknown	?	-
e. Known industrial - None	-	-
f. Direct precipitation* -	53,300	6.9
Total	776,870	100.0

2. Outputs -

Reservoir outlet - Delaware River 515,860

3. Net annual N accumulation - 261,010 kg.

* See Working Paper No. 175.

D. Non-point Nutrient Export by Subdrainage Area:

Tributary	kg P/km²/yr	kg N/km²/yr
Delaware River (A-3)	37	244
Slough Creek	16	223
Little Slough Creek	32	175
Rock Creek (E-2)	22	301

E. Mean Nutrient Concentrations in Ungaged Streams:

Tributary	Mean Total P Conc. (mg/l)	Mean Total N Conc. (mg/l)
Brush Creek	0.021	1.077
Evans Creek	0.066	0.812
Fishpond Creek	0.130	2.270

F. Yearly Loads:

In the following table, the existing phosphorus loadings are compared to those proposed by Vollenweider (Vollenweider and Dillon, 1974). Essentially, his "dangerous" loading is one at which the receiving water would become eutrophic or remain eutrophic; his "permissible" loading is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic loading would be considered one between "dangerous" and "permissible".

Note that Vollenweider's model may not be applicable to water bodies with short hydraulic retention times.

	Total Phosphorus		Total Nitrogen	
	Total	Accumulated	Total	Accumulated
grams/m^2/yr	2.07	1.57	15.7	5.3

Vollenweider phosphorus loadings ($g/m^2/yr$) based on mean depth and 5-year median hydraulic retention time of Perry Reservoir:

"Dangerous" (eutropaic loading)	0.44
"Permissible" (oligotrophic loading)	0.22

V. LITERATURE REVIEWED

Anonymous, 1975. Final environmental statement: Operation and maintenance, Perry Lake, Kansas. U.S. Army Engr. Distr., Kansas City, MO.

Kring, R. Lynn, 1977. Personal communication (revised reservoir morphometry; primary productivity). KS Dept. of Health & Environmen., Topeka.

Vollenweider, R. A., and P. J. Dillon, 1974. The application of the phosphorus loading concept to eutrophication research. Natl. Res. Council of Canada Publ. No. 13690, Canada Centre for Inland Waters, Burlington, Ontario.

VI. APPENDICES

APPENDIX A

LAKE RANKINGS

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P
2001	CEDAR BLUFF RESERVOIR	0.017	0.055	431.667	4.217	10.800	0.004
2002	COUNCIL GROVE	0.064	0.638	465.889	9.789	10.400	0.029
2003	ELK CITY	0.030	0.590	490.400	3.212	14.000	0.003
2004	FALL RIVER RESERVOIR	0.053	0.470	472.667	7.683	9.200	0.016
2005	JOHN REDMOND RESERVOIR	0.110	1.250	492.667	9.467	8.200	0.066
2006	KANOPOLIS RESERVOIR	0.056	0.640	487.000	16.033	10.200	0.011
2007	MARION RESERVOIR	0.052	0.431	483.667	12.400	9.000	0.010
2008	MELVERN RESERVOIR	0.034	0.265	494.111	38.400	14.400	0.027
2009	MILFORD RESERVOIR	0.079	0.732	486.333	19.883	12.400	0.036
2010	NORTON RESERVOIR	0.122	0.118	476.750	21.360	8.000	0.036
2011	PERRY RESERVOIR	0.055	0.478	476.571	5.614	13.400	0.017
2012	POMONA RESERVOIR	0.048	1.248	481.333	6.312	13.000	0.121
2013	TORONTO RESERVOIR	0.067	0.425	488.500	6.583	13.000	0.011
2014	TUTTLE CREEK RESERVOIR	0.102	0.478	478.667	11.278	13.600	0.067
2015	WILSON RESERVOIR	0.021	0.265	445.222	6.067	13.400	0.004

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	2001	CEDAR BLUFF RESERVOIR	539
2	2015	WILSON RESERVOIR	439
3	2007	KANOPA RESERVOIR	357
4	2003	ELK CITY	356
5	2004	FALL RIVER RESERVOIR	329
6	2008	MELVERN RESERVOIR	325
7	2013	TORONTO RESERVOIR	303
8	2010	NORTON RESERVOIR	292
9	2011	PERRY RESERVOIR	279
10	2006	KANOPOLIS RESERVOIR	271
11	2012	POMONA RESERVOIR	267
12	2002	CANCIL GROVE	231
13	2009	MILFORD RESERVOIR	214
14	2005	JOHN REDMOND RESERVOIR	144
15	2014	TUTTLE CREEK RESERVOIR	139

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE SIZE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	SUB-MEAN SECC	MEAN CHLORA	15-MIN 2D	MEDIAN DIS>MAG P	INDEX NO
2861	CEDAR BLUFF RESERVOIR	100 (144)	100 (144)	100 (144)	93 (133)	57 (81)	69 (123)	539
2862	COUNCIL GROVE	29 (41)	29 (41)	35 (50)	43 (61)	64 (91)	29 (41)	235
2863	ELK CITY	86 (123)	50 (71)	7 (10)	100 (143)	7 (10)	100 (143)	356
2864	FALL RIVER RESERVOIR	57 (81)	57 (81)	14 (20)	71 (101)	79 (113)	50 (71)	329
2865	JOHN REDMOND RESERVOIR	14 (20)	2 (3)	6 (9)	50 (71)	93 (133)	7 (10)	164
2866	KANOPOLIS RESERVOIR	43 (61)	43 (61)	29 (41)	21 (30)	71 (101)	64 (91)	271
2867	MARION RESERVOIR	64 (91)	64 (91)	43 (61)	29 (41)	86 (123)	71 (101)	357
2868	MILFORD RESERVOIR	79 (113)	82 (117)	86 (123)	8 (11)	6 (8)	79 (113)	324
2869	MILFORD RESERVOIR	21 (30)	36 (51)	79 (113)	14 (20)	50 (71)	14 (20)	214
2870	NORTON RESERVOIR	7 (10)	93 (133)	64 (91)	7 (10)	100 (143)	21 (30)	292
2871	PERRY RESERVOIR	50 (71)	10 (14)	57 (81)	85 (121)	35 (50)	43 (61)	279
2872	PAWNEE RESERVOIR	71 (101)	7 (10)	50 (71)	64 (91)	36 (51)	36 (51)	257
2873	TORONTO RESERVOIR	36 (51)	71 (101)	21 (30)	79 (113)	36 (51)	57 (81)	301
2874	TUTTLE CREEK RESERVOIR	8 (11)	10 (14)	71 (101)	36 (51)	14 (20)	8 (11)	136
2875	WILSON RESERVOIR	93 (133)	82 (117)	93 (133)	57 (81)	35 (50)	69 (123)	435

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107×10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX C

TRIBUTARY FLOW DATA

[illegible]

APPENDIX D

PHYSICAL and CHEMICAL DATA

[illegible]

[illegible]

STORET RETRIEVAL DATE 76/05/03

201143
38 09 53.0 095 27 33.0 3
PERRY RESERVOIR
20087 KANSAS
19110C

11EPALES 2111202
0037 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
74/04/12	12 40	0000	18.7		24		8.40	174	0.091	0.700	0.420	0.016
	12 40	0005	18.5	10.8			8.40	174	0.056	0.500	0.420	0.016
	12 40	0015	18.5	10.8			8.35	175	0.070	0.500	0.410	0.016
	12 40	0030	18.5	10.2			8.35	174	0.070	1.600	0.410	0.016
	12 40	0046	18.5	10.2			8.35	174	0.170	1.400	0.900	0.021
74/06/26	10 30	0000	23.6	7.8	12	392	8.30	160	0.056	1.400	1.400	0.024
	10 30	0005	23.5	5.4		393	8.20	158	0.050	0.400	1.450	0.027
	10 30	0015	23.0	5.4		395	8.00	164	0.250	0.300	1.510	0.022
	10 30	0030	20.2	3.6		394	8.00	166	0.090	0.300	1.630	0.022
	10 30	0044	21.0	2.4		387	8.00	166	0.070	0.400	1.640	0.021
74/10/02	10 25	0000	17.3	6.4	18	327	8.05	170	1.030	0.400	0.790	0.015
	10 25	0005	17.3	6.4		335	8.20	166	0.040	0.400	0.800	0.016
	10 25	0015	17.3	6.4		335	8.25	168	0.030	0.500	0.800	0.016
	10 25	0030	17.3	6.4		333	8.07	165	0.036	0.400	0.800	0.016
	10 25	0044	17.3	6.4		331	8.11	169	0.025	0.400	0.780	0.025

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
74/04/12	12 40	0000	0.044	6.6	
	12 40	0005	0.041		
	12 40	0015	0.044		
	12 40	0030	0.044		
	12 40	0046	0.042		
74/06/26	10 30	0000	0.074	1.5	
	10 30	0005	0.055		
	10 30	0006			1.0
	10 30	0015	0.044		
	10 30	0030	0.110		
	10 30	0044	0.031		
74/10/02	10 25	0000	0.044	6.2	
	10 25	0005	0.044		
	10 25	0015	0.055		
	10 25	0030	0.055		
	10 25	0044	0.067		

[illegible]

[illegible]

APPENDIX E

TRIBUTARY AND WASTEWATER TREATMENT PLANT DATA

[illegible]

DATE	TIME	DEPTH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible] A VALUE FROM TO BE
[illegible] LESS THAN INDICATED

STORET RETRIEVAL DATE 76/05/xx

301142
39 15 25.0 095 29 11.0 4
DELAWARE RIVER
20 7.5 VALLEY FALLS
T/PERRY RESERVOIR 291248
SR 4 IN MAIN .5 MI E OF VALLEY FALLS
11EPALES 2111204
0017 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/11/04	15 15		1.440	1.100	0.047	0.125	0.150
74/12/14	14 35		0.340	1.500	0.030	0.110	0.140
75/01/11	10 55		0.440	1.300	0.084	0.205	0.280
75/02/04	14 40		0.440	2.100	0.232	0.104	0.320
75/03/04	14 55		1.000	1.250	0.124	0.116	0.180
75/04/12	09 40		0.300	0.400	0.110	0.047	0.140
75/05/11	09 30		0.125	1.050	0.050	0.090	0.140
75/05/24	04 55		0.095	1.050	0.027	0.040	0.126
75/06/07	10 24		1.200	0.400	0.025	0.103	0.321
75/06/21	10 15		1.460	0.450	0.015	0.105	0.320
75/07/13	08 15		1.005	0.450	0.020	0.070	0.146
75/07/27	07 30		0.810	0.450	0.020	0.040	0.110
75/08/16	04 20		0.085	0.400	0.045	0.060	0.140
75/09/07	04 25		0.300	0.450	0.315	0.070	0.200

STORET RETRIEVAL DATE 75/05/09

201143
39 22 28.0 096 28 45.4 2
DELAWARE RIVER
20 7.5 VALLEY FALLS
TAYLOR RESERVOIR 091141
SMALL IN N+S +C 1 ** + 6 2 ** N ALT FALLS
21KSALES 2011204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3+NH4- N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/10/12	10 10		0.260	1.400	1.445	0.143	0.380
74/11/09	10 00		0.352	0.400	0.740	0.250	0.190
74/12/14	10 05		0.352	0.700	0.025	0.110	0.140
75/01/11	11 30		0.466	1.500	0.204	0.130	0.166
75/02/09	10 05		1.480	1.400	0.440	0.176	0.270
75/03/09	10 30		1.255	1.350	1.234	0.144	0.280
75/04/12	10 05		0.216	0.450	0.025	0.136	0.236
75/05/11	10 40		0.440	1.500	0.015	0.115	0.496
75/05/24	10 30		0.540	1.500	0.030	0.150	0.386
75/06/07	10 50		1.250	1.400	0.050	0.150	0.400
75/06/21	10 30		1.400	1.450	0.015	0.140	0.720
75/07/13	08 50		0.125	0.300	0.010	0.130	0.166
75/07/27	08 00		0.096	0.550	0.020	0.130	0.236
75/08/10	04 50		0.045	0.550	0.030	0.055	0.226
75/08/07	10 05		1.260	1.050	0.015	0.145	0.386

[illegible]

[illegible]

DATE	TIME	DEPTH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
YR	DY		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
YR	DAY	FEET	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
74/10/12	12	45	[illegible]	[illegible]	[illegible]	[illegible]	
74/11/04	12	58	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
74/12/04	13	15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
75/01/13	13	39	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
75/02/06	12	55	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
75/02/25	10	39	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
75/04/23	11	29	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
75/05/11	12	35	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
75/05/26	14	25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
75/06/17	13	47	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
75/06/21	12	46	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
75/07/13	12	39	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
75/07/29	11	08	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
75/08/18	12	15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
75/09/07	12	31	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]

DATE	TIME	DEPTH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
FROM	TO	OF	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		FEET	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	12	15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	11	30	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	12	20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	13	15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	12	05	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	10	35	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	11	25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	12	40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	11	25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	12	30	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	11	50	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	10	45	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	12	40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	12	15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

* VALUE [illegible] TO BE
LESS THAN INDICATED

[illegible]

[illegible]

DATE	TIME	DEPTH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
FROM	OF	OF TOTAL	N	TOTAL	[illegible]		
TO	DAY	FEET	MG/L	MG/L	MG/L	MG/L	MG/L
[illegible]			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]
[illegible]

STORET RETRIEVAL DATE 76/05/04

21151
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/10/12	09 15		0.2[illegible]	4.400	0.403	0.025	
74/11/09	09 05		1.300	1.500	0.400	0.025	0.040
74/12/[illegible]	09 50		0.740	0.250	0.020	0.005	0.020
75/01/11	10 70		1.400	1.300	0.072	0.035	0.025
75/02/08	09 15		[illegible]	0.700	0.050	0.015	0.030
75/03/08	09 25		0.405	0.750	0.014	0.004	0.020
75/04/13	09 10		0.271	0.475	0.025	0.010	0.020
75/05/11	09 05		0.660	1.030	0.035	0.025	0.215
75/05/24	10 25		0.090	1.100	0.090	0.025	0.090
75/06/07	08 55		1.650	1.000	0.040	0.030	0.120
75/06/21	10 35		1.300	1.700	0.020	0.035	0.130
75/07/13	07 15		0.730	0.400	0.040	0.005K	0.040
75/07/27	06 30		0.320	1.150	0.210	0.010	0.130
75/08/10	08 45		1.000	3.300	0.200	0.030	0.260
75/09/07	09 10		0.640	1.450	0.175	0.040	0.230

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE [illegible]

[illegible]

			00630	00625	00610	00671	00665
DATE FROM TO	TIME OF DAY	DEPTH FEET	NO2&NO3 N-TOTAL MG/L	TOT KJEL N MG/L	NH3-N TOTAL MG/L	PHOS-DIS ORTHO MG/L P	PHOS-TOT MG/L P
74/10/12	09 35		[illegible]	1.400	0.055	0.045	[illegible]
74/11/09	14 40		0.400	0.700	0.150	0.023	0.240
74/12/14	09 45		[illegible]	0.700	0.015	0.005	0.040
75/01/11	10 00		2.000	1.600	[illegible]	0.030	0.170
75/02/08	[illegible] 35		[illegible]	1.400	0.040	[illegible]	0.040
75/03/0[illegible]	09 05		0.005	0.400	[illegible]	0.012	0.040
75/04/12	08 55		0.025	0.400	0.020	[illegible]	0.020
75/05/11	08 45		0.500	1.200	0.040	0.015	0.180
75/05/24	09 00		1.000	[illegible]	[illegible]	0.025	0.120
75/06/07	14 40		0.510	0.800	0.025	0.025	0.120
75/06/21	09 45		[illegible]	0.450	0.015	0.025	0.070
75/07/13	07 35		[illegible]	0.500	0.040	0.015	0.030
75/08/16	[illegible] 30		1.050	0.600	0.255	0.015	0.050
75/09/07	08 45		1.150	1.200	0.075	0.055	0.230

[illegible]

[illegible]

DATE	TIME	DEPTH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
FROM	OF		[illegible]	%	TOTAL	[illegible]	
TO	DAY	FEET	MG/L	MG/L	MG/L	MG/L P	MG/L P
[illegible]	13	00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	13	05	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	13	10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	17	20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	13	05	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	14	10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	11	25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	12	40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	14	50	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	13	50	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	12	55	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	12	40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	13	10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	12	45	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

STORET RETRIEVAL DATE 76/05/14

[illegible] [illegible] [illegible]
39 34 00.0 075 32 00.0 [illegible]
[illegible]
[illegible] [illegible]
[illegible] [illegible]
DELAWARE [illegible]
[illegible] [illegible]
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3+NH4- N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
75/02/24	14 00		4.640	28.000		5.000	4.900	0.590	0.540
75/03/31	09 00		5.400	13.000	0.230	5.700	6.700	0.320	0.365
75/04/23	07 45		4.700	5.200	0.110	6.000	6.200	0.604	0.605
75/05/14	10 10		17.300	4.700	0.240	4.200	4.700	0.604	0.590
75/06/04	08 30		10.500	3.700	0.100	5.500	7.200	0.720	0.690
75/06/26	10 00		7.400	4.400	0.190	5.200	5.500	0.500	0.544
75/07/16	10 00		10.500	3.750	0.400	7.500	7.500	0.600	0.596
75/08/07	11 00		13.500	14.000	0.500	6.600	4.400	0.744	0.645
75/08/25	11 00		5.10[illegible]	12.500	0.350	7.700	12.500	0.745	0.689
75/09/17	11 00		5.600	15.500	0.620	8.200	4.500	0.600	0.590
75/10/08	10 30		5.600	11.000	0.097	10.500	12.000	0.500	0.580
75/10/31	14 00		14.700	15.000	0.175	4.400	17.500	0.590	1.554
75/12/03	11 [illegible]		10.500	14.500	0.140	6.100	4.650		

[illegible]

[illegible]

[illegible]										
[illegible]										
[illegible]										
[illegible]										
[illegible]										
[illegible]										
[illegible]										
[illegible]										
[illegible]										
[illegible]										
[illegible]										
[illegible]										
[illegible]										
[illegible]										
[illegible]										

[illegible]

STORET RETRIEVAL DATE 76/05/04

[illegible]

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3+NH4- N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50052 CONDUIT FLOW-MGD MONTHLY
75/02/27	09 00		6.730	74.000	3.400	2.410	11.000		
75/03/27			2.400	26.500	7.300	6.000			
75/04/16	10 30		3.400	11.500	0.290	0.250	4.300	0.029	0.029
75/05/05	08 15		4.500	6.500	0.050	5.500	11.000	0.035	0.041
75/05/27	08 00		5.300	6.300	0.100	5.000	11.300	0.027	0.027
75/06/10	08 00		7.200	2.650	0.050K	2.700	4.800	0.030	0.024
75/07/07	07 30		7.700	5.700		5.900	7.700	0.035	0.041
75/07/22	08 30		7.000	3.000	0.290	10.500	12.500	0.019	0.019
75/08/12	09 00		10.500	2.000	0.140	12.000	12.500	0.016	0.016
75/09/03	08 30		10.500	2.900	0.050	11.500	11.500	0.019	0.019
75/09/24	09 00		10.500	3.700	0.125	13.300	13.500	0.027	0.019
75/10/15	09 00		6.300	3.300	0.075	12.000	12.000	0.029	0.019
75/11/06	09 15		8.400	12.000	0.240		10.500	0.027	0.027

K VALUE KNOWN TO BE
LESS THAN INDICATED